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Book Review | *Plato's Camera: How the Physical Brain Captures a Landscape of Abstract Universals*

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***Plato's Camera: How the Physical Brain Captures a Landscape of Abstract Universals*; Paul M. Churchland, Cambridge, MA: The MIT Press, 2012; 299 pages (inclusive of a ten-page Preface and a one-page Appendix); \$35.00 hardcover; ISBN 978-0-262-01686-5**

For decades now, Paul Churchland has been developing a neurophilosophical research program capable of bringing the findings of neuroscience, and more specifically of cognitive neurobiology, to bear fruitfully on some longstanding problems in philosophy of mind, epistemology, and metaphysics—problems whose roots stretch all the way back to Plato. His most recent volume, *Plato's Camera*, carries on this pursuit with an explicit focus on the neurocognitive operations behind perception, the rise of background conceptual frameworks, the redeployment of conceptual frameworks to ever-expanding domains of phenomena, and our language dependent institutions that drive cultural changes and collective cognitive adventures. His ultimate goal is to delineate the explanatory advances in the philosophy of mind, epistemology, and philosophy of science that are there for the taking once the brain's sub-symbolic kinematical and dynamical resources are fully appreciated and recent insights from connectionist-network theory are fully utilized.

Plato's Camera begins with a short introductory chapter that offers a very condensed but helpful overview of the coming chapters' contents. Chapters Two and Three deal with the structural changes in the brain that give rise both to an enduring conceptual framework and the capacity to evaluate this framework—what Churchland calls First-Level Learning. Chapter Four looks at how the brain redeploys the enduring concepts acquired by First-Level Learning—what he calls Second-Level Learning. Chapter Five, Churchland's final chapter, explores the role of language and of the cultural institutions arising from the use of language in the regulation and amplification of First- and Second-Level Learning—

predictably, this is what Churchland dubs Third-Level Learning. The book concludes with a brief one-page appendix that deduces Kepler's Third Law from Newtonian mechanics.

As Churchland's title suggests, he believes the biological brain is an organic camera that "takes pictures" of reality's most fundamental timeless and changeless dimensions, viz., abstract universals, temporal invariants, and enduring symmetries (vii). What Churchland really means is that the brain makes *maps*, millions of high dimensional maps with extraordinary resolution and detail that constitute our background conceptual frameworks. These maps packed into our brain are not linguaformal, or families of predicate-like elements, but rather large populations of high-dimensional prototype points and trajectories configured by relations of proximity and distality that mirror, to varying degrees, certain of the abstract invariants of the external world. These maps are Churchland's biologically realistic versions of Plato's Ideal Forms: high-dimensional structural homomorphs of the objective and abstract feature-domains of external realities (123). Our brains, which generate, operate, and deploy these maps, are profoundly representational entities, but not in the way that past logocentric philosophers have thought. The brain's representational and cognitive capacities do not arise from manipulating propositional structures, or from any innate language-like primitives, but from the sub-symbolic vector coding, matrix processing, and map-constructing performed by cadres of synaptic connections within the brain. The task of *Plato's Camera* is to convince us of this theory and to demonstrate how this neurocomputational framework helps us find our way out of a number of perennial philosophical dead-ends in epistemology, philosophy of mind, and philosophy of science.

In the early chapters of the book, Churchland illuminatingly compares and contrasts his scientific and empirically grounded account of the internal machinery of cognition to that of Kant's transcendental and speculative account. Space and time were, on Kant's account, pure forms of sensory intuition, while the pure concepts of understanding constituted the universal and unchanging framework of human judgments. These two manifolds (abstract structured spaces—what Churchland calls "maps") of human experience and judgment were for Kant the a priori means through which human cognition arose and came to expression. Churchland, however, wants to make some rather dramatic changes to Kant's account: specifically, he wants to replace Kant's innate universal and unchanging maps with acquired changeable and local maps, maps built up by and shaped through the ongoing experience of the developing animal such that the animal's brain's synaptic modifications bear the structural impress of the environment and of the practical demands the environment places on the animal. Moreover, he wants to expand the number of maps beyond Kant's miserly pair into the thousands so they include not just perceptual and conceptual representational spaces, but also maps for the motor behavior and skills of the organism. Clearly, for

Churchland, these representational spaces are not proprietary to humans, but are physically realized in discrete anatomical locales of all animal brains (4).

Furthermore, contrary to Kant's account, judgment is not the fundamental unit of cognition. According to Churchland, judgment and all the logical relations it depends upon arrive much later (phylogenetically and ontogenetically) when language finally comes into the picture (a function of Third-Level Learning). Kant, having language as his only example of a systematic mapping/representational framework, reasonably enough thought that language-like structures were essential to the basic machinery of cognition. In Churchland's account of the primitive units of representation and thus of cognition, Kant's *linguaformal* primitives are replaced by activation patterns across proprietary populations of neurons—something all organisms with nervous systems possess. The avoidance of species chauvinism and its concomitant logocentrism, a fault common to Kant and his later nativist descendants like Chomsky and Fodor, is a feature of Churchland's account that he tirelessly advertises (4, 5, 33, 67). A long overdue alternative to the sentential/propositional-attitude model of cognitive activity—a model that has dominated philosophy for over two millennia—has finally arrived in the convergence of neurobiology and artificial neural network theory, enabling researchers to make some explanatory contact with neurostructural and neurofunctional details of the brain that sustain cognitive activity throughout the whole animal kingdom (14).

According to Churchland's thoroughly cognitive neuroscientific outlook, there are three fundamental types of learning constitutive of normal human intelligence. First, there is the slow and structural learning that every cognitively apt brain *has undergone*; next there is the volatile and dynamic learning that every cognitively apt brain *constantly undergoes*, and finally there is the learning that *only* cognitively apt *humans* possess which regulates and amplifies the accomplishments of the first two kinds of learning (a kind of learning that is unique to language users). First-Level Learning is where sensory and motor experience sculpt (via metrical deformation and reformation) the space of possible activation patterns across the brain's 10^{14} synaptic connections to produce a coherent and hierarchical family of prototype representations/maps to function as a background conceptual framework of cognition. Such synaptic sculpting is a slow unconscious process, taking days, weeks, and even years to produce high-dimensional maps of the external structural, temporal, and causal invariances of the objective world. These background high-dimensional maps are constantly updated by virtue of reliable perceptual-indices that track the organism's current placement in the maps' feature-spaces. First-Level Learning operates prior to and independent of the more familiar category- and language-dependent processes of induction, hypothetico-deduction, and even Bayesian learning. The real mechanism of this fundamental form of experience-dependent, tacit learning is Hebbian learning, a purely

structural type of synaptic adjustment and entrenchment common to all terrestrial nervous systems, whose fundamental operations are summed up in the aphorism “neurons-that-fire-together-wire-together” (158). At this pre-categorical level, we have “learning that needs no antecedent conceptual framework in order to get an opening grip on the world”; nor does it depend on supervision by a prescient agent to accomplish this task (164). It is a learning whereby uninterpreted spatial and temporal patterns of input energy from a creature’s sensory experience gradually craft differential sensitivity to axonal activations, forming “the background conceptual framework in which subsequent sensory inputs are preferentially interpreted” (165).

Second-Level Learning is quite simply “the redeployment of some background conceptual map, already at work in some domain or other, into a new and unexpected domain of phenomena” (231), and as such, we might understand Churchland’s book as a grand object lesson in what Second-Level Learning can produce. Fundamentally, Second-Level Learning refers to the brain’s self-modulating and all-up neuronal activation vectors and trajectories that subserve perceptual and cognitive expansion. According to Churchland, the dynamical changes of this second level of learning take place on a much shorter timescale than the structural changes gradually effected by First-Level Learning (16). Second-Level Learning is all about conceptual changes that just are, in Churchland’s view, changes taking place in an animal’s neuronal activation spaces already sculpted by First-Level Learning—changes driven by proximal stimuli that occur within the organism millisecond-by-millisecond, but which effect no immediate structural changes. He depicts the brain’s dynamical activity in this kind of learning as a single moving point in the brain’s entire neuronal activation space, “a point in ceaseless motion, a point that spends its time, marble-like, rolling merrily around the almost endless hills and valleys of the conceptual landscape that the basic or structural learning process has taken so long to sculpt” (17). Second-Level Learning is therefore a cognitivist analogue of what evolutionary psychologists call evolutionary “exaptation”: devices originally developed within one environment turning out to serve differently but unexpectedly well in a new environment. Churchland’s favorite example of this is Newton’s paradigm-changing insight that the Moon is a projectile: “Newton’s sudden re-perception/reconception of the Moon’s familiar but highly puzzling elliptical trajectory ... as being just a large-scale instance of a flung stone’s trajectory here on Earth” (192). Second-Level Learning described in terms of high-dimensional neuronal kinematics for cognitive activity in general and vector-processing dynamics for perceptual activity in particular, yields, in a non-linguaformal and naturalistic format of overlapping conceptual maps, an epistemological framework for cognitive activity “that sustains a *correspondence* theory of our actual representational success” and “a *coherence* theory of how our representations are evaluated, by *us*, for their representational success or failure” (202). Because this kinematical and dynamical framework reveals “the brain’s capacity to get an

increasingly broad and penetrating grip on the structure of the larger reality of which it is a part" (247-8), Churchland argues that it provides sufficient epistemological basis for an optimistic meta-induction capable of vindicating his long held but somewhat eccentric (given his recognition that even perception is theory-laden!) scientific realism.

Turning now to what Churchland calls "Third-Level Learning," we move from his delineation of both the slow and fundamental structural level of learning of individuals as well as their swift meta-operations of dynamical level learning to what "may be the single most important development in the evolutionary history of the entire hominid line" (252). Third-Level Learning is a language-dependent learning that enables a mutual steering and modulation of the cognitive activities of one's fellow speakers, such that collective, cooperative, and common cognitive endeavors that exploit and regulate the first two levels of learning become possible for the first time. At this level of learning, brains can interact in radically new ways that were impossible prior to a shared language. Of Churchland's three levels of learning, the third level of learning is, so far as we know, unique to humans: he doesn't think it is a coincidence that no other terrestrial creature "comes within light-years of our own epistemic achievements, and no other terrestrial creature commands language" (253).

Churchland notes that although no epistemology or philosophy of science prior to the present has had any clear conception of the first two levels of learning he details in this book, there has been no shortage of theories about the workings of this third level of learning. In his view, the sorry situation of philosophy and science up to the present has been one of chronically mischaracterizing the operations of the first two levels in terms of the logocentrism of this third level—i.e., as merely hidden, internal versions of the linguistic representations and operations of third level cognitive activity. Thanks to a number of discoveries and theoretical advances in recent neuroscience and artificial neuro-modeling, we now are capable of recognizing the sublinguistic, high dimensional cartographical styles of representation and computation that underpin this public and supra-individual level of learning. The domain of Third-Level Learning is where the semantic content of public language and of individual conceptual frameworks decouples from our human genome and opens to cultural suasions, and where each individual's advancements on his or her First-Level and Second-Level Learning is no longer limited to his or her lifespan, but gains a potential immortality in being off-loadable to language-dependent public structures of inter-generational transmission and preservation (253).

Due to the technicality of many of the topics covered in this book, it would not be a good place to start for someone interested in but largely unacquainted with Churchland's neurocomputational philosophy. However, readers already somewhat familiar with his

revisionist research trajectories in epistemology, philosophy of mind, and philosophy of science and intrigued by his quest to constrain computational modeling of the brain based on knowledge of its structural, kinematical, and dynamical properties will find much to relish in this rigorous work. Such a reader will find that although Churchland does not really break any new ground in this work (except perhaps near the end of the book where he develops the inter-generational social and cultural impact of the linguistic constructivism of Third-Level Learning), he does extend and helpfully clarify a number of his longstanding views. To be sure, in this book, he consolidates his quest to eliminate propositional-attitude psychology so that the co-evolution of connectionist psychological modeling and neuroscience can flourish and eventually move toward unification through a series of inter-theoretic reductions.

Churchland's prose is direct, concise, and clear. If he isn't always exactly fair in his representations of opposing positions (e.g., he hardly does justice to nativism in its more recent nuanced and sophisticated refinements), or if he doesn't always engage the full array of alternative accounts bearing on some of the issues he addresses (e.g., he fails to address any of the alternative computational-representational frameworks formulated recently by advocates of explanatory pluralism, proposals that also encourage co-evolution of theories pitched at different levels of description, but which refuse to give priority to lower-level descriptions), he can be forgiven for these because his captivating forays into a vast array of bordering topics, and the variety of interesting examples and illuminating illustrations through which he zestfully conveys his own positions are, at least to this reader, reward enough.

However, the one flaw in this book that I cannot find it within myself to pardon is Churchland's failure to even comment on, let alone carefully to address, the basis on which he so easily slides up from micro-descriptions of neuronal activation vector matrixes and trajectories in the brain to macro-changes in a psychological agent's concepts and cognitive activities. I suspect, the reason Churchland feels entitled to such easy description-level upgrades is that he believes ultimately, once the logocentric dynamics and kinematics of the "High Church Computationalism" that purportedly underwrites propositional-attitude psychology are repudiated and replaced by his ocularcentric connectionist maps and their high-dimensional vector-to-vector transformations, a smooth inter-theoretic reduction of these levels of description will be forthcoming, vindicating his hunch that cognition is really nothing but these connectionist maps and their high-dimensional vector-to-vector transformations, that his ocularcentric metaphorics, once embraced, will become *literally* true.

In concluding this rather selective review of *Plato's Camera*, I'd like to raise an issue that goes to the heart of Churchland's project. It can be summed up in a question: Does the plausibility of his admittedly impressive and provocative account of the neuro-computational underpinnings of human cognition arise merely from the bewitching ease with which he describes different energy transformations as different cognitive transformations? By describing certain transductions of energy from the environment to the central nervous system as the brain's taking of pictures and making of maps, Churchland gives the impression that he is making progress in naturalizing conceptual origination and cognitive function, when in reality all that is objectively taking place is energy of one sort is being transduced into energy of another sort, e.g., electromagnetic to electro-chemical. After all, once certain physical processes in the brain are accepted as pictures or maps, all the really hard and controversial work is already done, at least when it comes to explaining how the brain's activities can be *about* or represent anything, including itself. In the final analysis, I must confess that my reading of *Plato's Camera* was haunted by the niggling suspicion that Churchland, by mere fiat, front loaded his descriptions of the sub-symbolic and sub-personal vagaries of energy transductions and transmissions with enough intentionality to make the traversing of the explanatory gap separating neuronal and psychological descriptions seem like a mere walk in the park. If my suspicion is correct, then perhaps Churchland has inadvertently provided a good case not for eliminativism, but for explanatory pluralism—an opposing outlook to his own that is not even mentioned in his book.